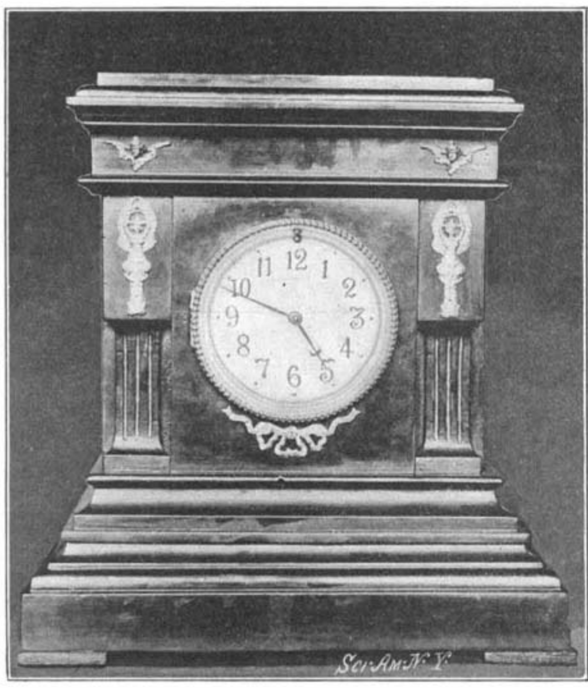
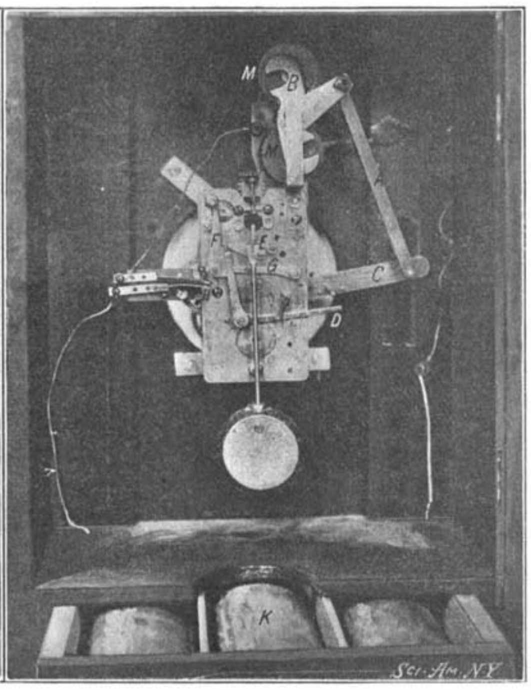
SELF-WINDING CLOCK.

BY DAY ALLEN WILLEY.

A simple winding mechanism for clocks has recently been perfected whereby a clock may be periodically wound by the action of an electro-magnet on an armature connected with the clock weight. In our illustration the connecting link *A* is weighted, and serves as the driving power for the clock movement. The link is secured at its upper end to an arm on the armature *B*. At the lower end it is connected to the lever *C*. A spring pawl on this lever engages a ratchet wheel, and the weight of link *A* serves slowly to rotate the wheel, which in turn operates the clock mechanism. When the weight drops to its lowest position, a pin on the lever *C* engages a bell crank *D*, which in turn lifts a latch *E*, out of engagement with a shoulder on lever *F*, permitting the latter to drop forward to the right. This movement brings the upper end of the lever *F* directly under a pin projecting from an extension of the escapement anchor of the clock. On the first swing of the pendulum toward the right, this pin is rocked downward, depressing the lever *F*, and lever *G*, on which it is mounted, and making an electric contact at *H*. The circuit of battery *K* through magnets *M* is thus closed. The magnets cause the armature *B* to swing on its axis, lifting the weight to its initial position. The contact at *H* is, of course, immediately broken on the return swing of the pendulum, and the parts are allowed to drop back to their normal positions. From five to eight minutes is required for the weight to reach its lowest position. In the ordinary-sized mantel clock, such as that illustrated, a battery of three dry cells is employed. These are placed in a drawer beneath the clockwork, and serve to wind up the clock for a period of about eight months without renewing. This system is also applicable to clocks with long pendulums, such as the cathedral type, the mechanism being, of course, proportionately larger and the magnets and battery more powerful.



SELF-WINDING CLOCK.



VIEW SHOWING DETAILS OF WINDING MECHANISM.

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THE ACTION OF A BIRD'S WING AND ITS BEARING ON THE PROBLEM OF MECHANICAL FLIGHT.

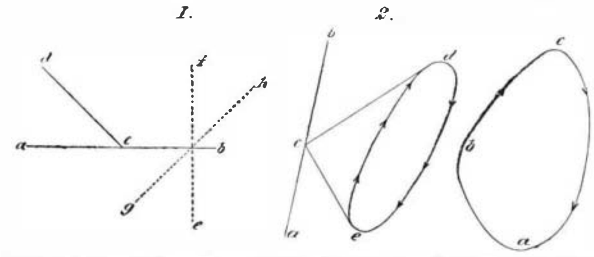
BY DR. T. BYARD COLLINS.

The precise action of a bird's wing is so difficult of observation that a close scrutiny has been persistently attempted only during comparatively recent years.

It has been shown that the muscles of a man are not adapted to the propulsion of wings, though the experiments of Lilienthal revealed some astonishing facts, as, for instance, that vibrating wings, of moderate size and of a certain form and structure, actuated by a kind of treadmill contrivance, could be made to lift half their own weight plus half the weight of the operator. This is the more interesting in view of the fact that almost at the same time these results were being obtained, and that with an apparatus admittedly crude and excessively heavy, a reputable engineer was demonstrating mathematically that a man-operated pair of wings, in order to lift the weight of a man, would have to have a surface of some acres in size. But while human flight with man-actuated wings attached to his body is highly improbable, the solution of the great problem by other means is now believed to be possible by the most competent thinkers on the subject.

The sailing and soaring birds have been profoundly studied; and, while there is no universally accepted theory as to the manner in which their wonderful phenomena are produced, it is still hoped by many that they may be imitated, and that some form of aeroplane or air-runner will eventually be evolved which will fulfill the demands of aerial navigation.

As bearing upon the same fascinating subject, the action of the wing of the bird in flight is being somewhat more carefully considered. Some years ago a writer for the Encyclopædia Britannica declared that the telling stroke was downward and forward, and that if it were otherwise, the bird would be pitched a somersault by its own activity. Prof. Hargrave asserted that a bird's wing revolved in a cone and acted as a modified trochoided plane. Prof. Pettigrew was the first, so far as I know, to try for a self-recorded diagram of a wing in action. For this purpose he used a sphygmograph, but his efforts seem not to have been very successful. Baden Powell caused a small bird to fly through a paper tube, the tube being smoked on the inside surface. When the tube was cut longitudinally and spread out, there were marks upon it from which Major Powell felt warranted in calling attention to the wing's alternate flexion and extension. Zanvrie remarked the change in the angle of incidence taking place in the course of a complete vibration, but, to this observer, the up and down strokes were delivered vertically.



a, b, the bird's body; *c, d*, the wing at the beginning of the down stroke, showing the upward, forward, and outward angle assumed. The dotted lines *e f* and *g h* represent the vertical and lateral axes of the body.

a, b, the bird's body; *c, d*, extreme reach of wing at moment of beginning the down stroke; *d, e*, line of descent, throughout which the wing is being flexed; *e*, extremity of down-stroke; *e, c*, shortest distance from the tip of wing to point of attachment.

Showing a possible modification of the ellipse when the wing is contracted not progressively, but suddenly when the down stroke has been practically completed; *c, a*, representing the down stroke, *a b* the line of contraction, and *b, c*, the upward stroke.

DIAGRAMS SHOWING THE ACTION OF A BIRD'S WING.

For the purpose of either correcting or verifying some observations of my own, a common pigeon was held lightly in hand and moved suddenly so as to induce efforts at flight. During these movements, flashlight photographs were secured from which, together with a record of motion, some deductions were subsequently drawn.

A pigeon was selected because it was considered a representative bird for the purpose. It weighed 15 ounces and its wings were each of 12 inches reach and 5 inches wide at the base. In flight they assumed nearly the form of a triangle, so that their total surface was, approximately, 60 square inches.

The record of motion was obtained by leading fine insulated wires from a battery to a small incandescent lamp, which was fastened to the tip of the wing. The bird was then induced to make efforts at flight as before stated, and the moving wing with the light attached was exposed, in a darkened room, to a photographic plate through the lens of a camera. The lamp was loosened and finally beaten off by the violent motion of the member, this fact also appearing in the record, where the lines become irregular and heavy, the moment of detachment being marked by a final blot.

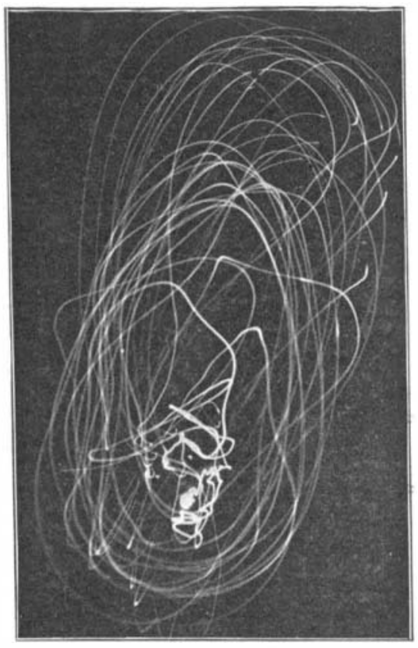


Fig. 3.—THE RECORD OF MOTION.

It is not claimed that a perfect record was obtained. Allowance must be made for the conditions under which the bird acted. Still, the transcript is legible, and that is, after all, the vital factor in an experiment of this kind.

Studying then the upper portion of the tracing, for the record is here more accurate than elsewhere, it would appear that, if the tip of the wing were to continue in the same plane, relatively to the vertical axis of the bird's body, throughout a complete vibration, it would describe an ellipsis upon the plane. But, while this complete vibration is being made, there is also a retraction and extension in the reach of the wing, as noted by Baden Powell, the flexion being indicated by the dip of the lines toward the left, or by their complete break, the tip being cut out of focus by some intervening portion.

At the beginning of the down stroke, the wing, extended to its utmost reach, assumes, relatively to the bird's body, an angle upward and forward of something like forty-five degrees, as shown in Diagram 1. It should be mentioned in this connection that the wing has not only the power of extension and flexion due to the movement of its joints, but the extent of surface exposed may be greatly modified from moment to moment by the opening and closing of the feathers upon themselves. Always in full flight, at the beginning of the down stroke, the greatest possible spread is exposed to the resistance of the air.

When alighting, the bird assumes nearly an erect posture, as any one may verify for himself by watching a pigeon alight in the street, and beats its wings *downward and forward*, and it is only when alighting that such movements are performed.

In Fig. 1 the wing has nearly completed its down stroke, and the point to be noted is the angle of incidence which it was making at the moment the camera caught it, an angle so small that but little of the surface is seen, giving the wing the appearance of disproportionate narrowness.

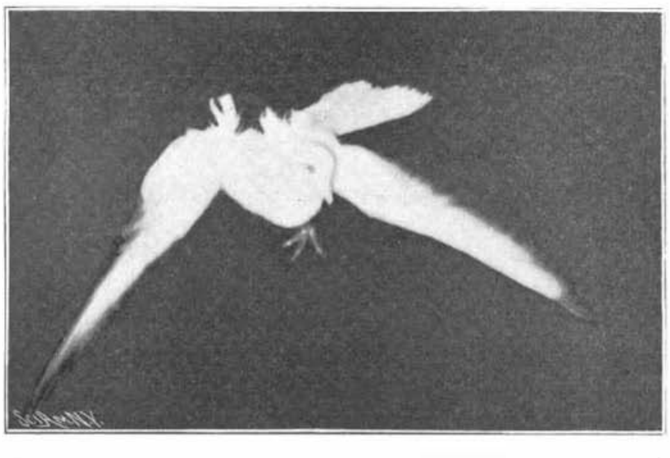


Fig. 1.—SHOWING THE ANGLE OF INCIDENCE WHEN THE WING HAD NEARLY COMPLETED ITS DOWN STROKE.

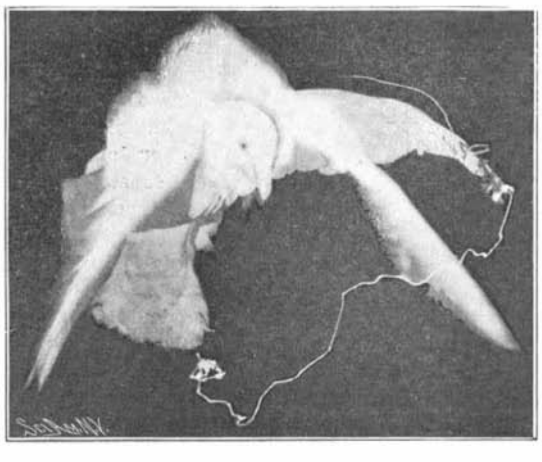


Fig. 2.—SHOWING THE WING AT THE INSTANT OF BEGINNING THE UP STROKE. ALSO THE EXTENDED WING WITH THE LAMP ATTACHED.

In Fig. 2 the plate was, by mistake, exposed twice and to different views. It is reproduced here because it was found impossible with the facilities at command to catch the bird a second time in the particular position herein presented. It shows the wing at the instant of beginning the up stroke. The position of the wing relative to the body may be observed, and the change in the angle of incidence, the under side of the wing showing now, whereas in Fig. 1, the wing making its down stroke, it was the upper surface instead.

The other view on the same plate shows the extended wing with the light attached.

Fig. 3 is the record of motion. The vibrations were not uniform; long strokes, short strokes, and flutters are alike transcribed, but, in general, the elliptical movement may be readily made out.

Diagram 2 shows this ellipse in its relation to the bird's body, the upper end of the ellipse being above and forward of the wing's attachment. The line *c d* represents the extreme reach as it is extended preparatory to a down stroke. The tip then traverses the line of the ellipse, the wing being progressively flexed throughout the downward movement, so that, upon reaching the lowest point, the wing's extremity is nearer the body than at any other moment of the cycle. At *e* the angle of incidence is changed from negative to positive, and the wing shoots upward, forward, and outward, cutting the air like the edge of a knife blade, thus regaining, without resistance, a point from which to deliver another telling stroke.

It is believed by the author that these movements are variously modified in different birds, and that in the same bird they may be and are modified as occasion requires. For instance, in vertical flight, the wing would smite the air nearly broadside on during its downward movement, the air being avoided during the up stroke by the flexion of the joints, the contraction of the feathers, the angle assumed and the direction of motion; the reduction of surface exposed being accomplished, not progressively, during the entire down stroke, but suddenly, when the stroke has practically been completed. (See Diagram 3.)

Vertical flight would then be accomplished by means of a reaction from the air which is smitten by the broad side of the blade, the edge only advancing to the point of attack. Horizontal flight is performed by a broad backward beat, the thin edge only again advancing to the point of attack; and any intermediate direction of flight *is the result of a combination of these movements.*

Now, the question arises as to whether the beating wing should not be given greater prominence in our plans for the attainment of mechanical navigation.

The aeroplane has been thoroughly tried. The most competent and fertile minds have given it years of laborious study, incredible patience has been bestowed upon it, and large sums of money have been expended in experimenting with it. Nor have these efforts been in vain, surprising phenomena having been produced. The most encouraging structure of this form is Mr. Langley's aerodrome, which made, in comparison with what had hitherto been done, a really wonderful showing; but it demonstrated the fact that an aeroplane pure and simple can never be a success as a weight-carrying device.

But it is said: If the great birds can sail and soar, why cannot a man-made machine do the same thing? And since it is obvious that less power is expended in this form of flight than in any other, it would seem reasonable that the aeroplane principle is the proper one to pursue.

But there is not a sailing bird which does not beat its wings when it starts to fly. The start is the difficult achievement, both with the bird and the man-made machine. Moreover, no bird bearing away its prey—its load—ever proceeds otherwise than by flapping its wings. *The reaction obtained from this movement is the vital thing.* And *movement* is the vital thing for stability also, as shown, for example, by the bicycle and the gyroscope.

The bird above described weighed within an ounce of a pound, and had a wing spread of 60 square inches—less than half a square foot to the pound. The most successful air-runner ever built weighed between 25 and 30 pounds and had 54 square feet of sustaining surface—approximately 2 square feet to the pound.

Comparing power employed, the engine of the air-runner developed more than a horse power. The bird's power was considerably less than 0.01 that of the man-made machine, or 0.3 weight for weight.

What will account for all these factors in favor of Nature's flying machine, since it is much heavier in proportion to size, has far less sustaining surface in proportion to weight, and but a small fraction as much power available? *It is the beating wing.*

* * *

The sand-blast as a substitute for soap, water, and scrubbing brush is a novel idea, but this has been used recently in the renovation of the Government Printing Office and the Treasury Building at Washington. A Chicago company has had a portable plant built for the purpose and engages in the business of cleaning the fronts of marble buildings in all parts of the country.

ELECTRIC LOCOMOTIVES FOR YARD AND SHOP WORK.

During the past decade there has been an increasing use made of the electric locomotive for general industrial purposes, and it is being rapidly introduced in the large manufacturing plants both in this country and Europe. Industrial electric locomotives may be divided into the following classes: First, mining locomotives for underground work; second, surface, narrow-gage locomotives for transporting material in brick yards, earthworks of whatever character, or the surface workings of collieries; third, factory locomotives and switching locomotives for use on standard-gage tracks in hauling and switching cars in the factory or upon its sidings; and, fourthly, tipping or foundry locomotives for use in foundries and steel mills.

The locomotives of the first three classes are usually standard types, and are often made to stock patterns, while the last requires special treatment to suit each individual case. The standard types are each provided with two motors, one on each axle, which are either geared to the axles by means of straight-toothed, cut gear wheels, or directly connected to the axles without the use of gearing. Where two motors are employed, all the axles being drivers, the whole weight of the locomotive is available for adhesion, and there is no necessity for carrying ballast. In locomotives employing one motor only, but half the weight of the locomotive is available for adhesion, and, as a result, it is a common thing for the wheels to skid, long before the full power of the motors is developed. Some manufacturers attempt to solve the difficulty by coupling the two axles together, as in steam locomotives. An important advantage in the use of two motors is that the series-parallel control can be employed, and it is thus possible to travel at half speed without having resistance in circuit, that is to say, without waste of energy, for with the motors in series the starting effort is almost doubled for a given current. Yet another advantage is that the use of two motors provides a certain reserve in case of accident, a simple movement of the controller enabling one or other of the motors to be used singly, but, of course, with a reduced load. A two-motor locomotive is much cheaper in proportion to its power than a locomotive with a single motor.

The storage battery locomotive, it is needless to say, has great adhesion on account of the weight of the batteries.

By the use of storage batteries, moreover, the trolley, which is often troublesome, is eliminated, and for certain classes of work this absence of the trolley renders the type peculiarly suitable. Speaking generally, it may be said that where the fire risk is an important consideration, the use of the electrically-driven locomotive becomes almost imperative.

In shops, foundries, and manufacturing establishments where heavy material is moved on narrow-gage cars, the electric locomotive is particularly serviceable on account of its great handiness and of the fact that it runs with perfect freedom around curves of as low as 12-foot radius. Among the principal applications of the narrow-gage type may be mentioned its work in taking trains of trucks from the pit mouth or tunnel entrance to the various sorting and washing buildings, or to the standard-gage cars for loading. It is also in great demand at quarries, sand pits, blast furnaces, and at sugar, coffee, and other plantations.

The compact little trolley locomotive shown at the top of the front page of this issue is used on the three-foot gage tracks in the rail mill of the National Steel Company. It carries two motors, one on each axle, which operate at a potential of 220 volts. The drivers are 30 inches in diameter; the wheel base is 5 feet, and the total weight is about 8 tons. The locomotive is 14 feet long, 10 feet high, and 4 feet 8 inches in width. In electric locomotives of this class it is customary to estimate the drawbar pull as one-fifth of the weight on the drivers; but in practical work on tracks that are liable to be wet or greasy, as is generally the case in shops and mills, the driving wheels will slip before the estimated drawbar pull is reached, and sanding the tracks is usually necessary under such conditions.

As there are no severe limiting dimensions to be considered in the surface locomotive, it differs altogether in form from the mining locomotive, although the construction of the truck is much the same. Upon the truck is mounted a roofed-in cab, as shown in the illustrations just referred to, and the driver stands upright in a position where he has the controller, brake, sand-box lever, and alarm gong placed conveniently behind.

The storage battery locomotive, which is shown below the illustration of the trolley locomotive just referred to, has a drawbar pull of 1,000 pounds; the weight of the battery is about 6 tons, and the machine may be operated either from the trolley wire or by the storage battery; moreover, it may be charged from the trolley wire, a feature which renders this locomotive a very valuable and flexible machine. It will be noticed that the battery box is carried on the top of the locomotive. The connections are such that it may be charged at the same time that the motors are being driven with the current supplied through the trolley.

Much attention has lately been given in coke-making plants to the question of transporting the lorry from the bins to the coke-ovens. In the outfit here shown an equipment of electrical motors has been applied with very satisfactory results. The frames of the motors have been so arranged that a simple and efficient connection can be made with the axles of the lorry.

Another important use of the electric locomotive has been found in the yard work connected with large modern blast-furnace plants. We show an illustration of an electric locomotive which is equipped with a special motor for tipping the ladle. The combining of the ladle and locomotive in one machine has been found to be very advantageous because of the ease of operation, the reduction in space, and the smaller number of parts. It will be seen that this form of construction is suited also for the tipping of wagons loaded with earth, coke, or minerals. The particular locomotive here shown is at work at some blast furnaces at Seraing, Belgium.

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Automobile News.

A new speed record of 27 seconds for the kilometer was made by the Hon. C. S. Rolls in Welbeck Park, Nottinghamshire, England, on February 26. A 72 h. p. Mors racer was used, and the rate at which it traveled was equal to 83 miles an hour. The best previous official record was 29 seconds, made November 17, 1902, by Augieres on a Mors car, in France. The record, which is 2 seconds better than the existing one, is not considered official, as the course was on a down grade.

The results of the 4,000-mile tire test conducted by the A. C. of Great Britain were announced recently. The tires awarded first prize were the Dunlop double tube; the Collier double-tube tires obtained the second prize; while the third prize was divided between three sets of Dunlop and one of Talbot tires. The Collier tire showed the least wear of any, but the dynamometer tests showed that the same car with these tires on pulled from 15 to 30 per cent harder than when fitted with Dunlop tires, and the resiliency was found to be less.

News comes from Worcester, Mass., that the Morgan Truck Company has completed and tested with success the largest automobile ever completed. The vehicle has a capacity of ten tons to a load, and is built entirely of steel. The motor used is a steam engine. The boiler is of the torpedo water-tube type. The automobile is so constructed that two or three loading bodies can be used, removing the trucks and running gear and placing them under another body, thus saving an enormous amount in time and expense of loading. Two big cranes are attached to the truck, operated by the engine, capable of lifting the largest steel beams or granite blocks. The total daily capacity of the truck is estimated at 400 tons.

The long-distance race on the Continent this year will be from Paris to Madrid—a distance over the route chosen of 531 kilometers, or 329¾ miles. The race will be run on three successive days—May 24, 25, 26. Among the French manufacturers who have entered machines are the following: Mors, 10 cars; Panhard-Levassor, 12; Renault Frères, 10; Dietrich, 9; Decauville, 4; Ader, 8. The manufacturers of the German "Mercedes" car have entered 6 machines; the makers of the Belgian "Pipe" machines have entered 4; England will be represented by Edge and Jarrott on Napier cars; and America by 2 Matheson machines, built by the motor car company of that name, Grand Rapids, Mich, and by H. S. Harkness and W. K. Vanderbilt, Jr., who will drive special cars which they are having built.

MM. Gobron and Richard have recently arranged a new classification of vehicles which is to be used in classifying the racers in the Circuit de l'Argonne. The idea is to use the total cylinder area, instead of the weight of the cars, as a basis of classification. The four classes to be arranged on this basis are as follows:

1. Total cylinder area equal to or less than 1.5 liters (91.53 cu. in.).
2. Total cylinder area equal to or less than 2.5 liters (152.55 cu. in.).
3. Total cylinder area equal to or less than 5 liters (305.11 cu. in.).
4. Total cylinder area equal to or less than 8 liters (488.17 cu. in.).

These four classes correspond to vehicles of from (1) 6 to 10 effective h. p.; (2) 15 to 18 h. p.; (3) 30 to 35 h. p.; (4) 40 to 50 h. p. The volume indicated is the product of the surface of the piston by the stroke and number of cylinders. Those who do not wish to reveal these dimensions, cannot enter the race; while the penalty of disqualification will more than suffice in case of fraud.